

Enabling Innovation; Using OLEDs and LEDs in Today's Fixtures

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BLACKJACK
LIGHTING

Everybody is asking me about OLEDs...

Are OLEDs ready to use in Fixtures?

Is OLED the next big thing in Lighting?

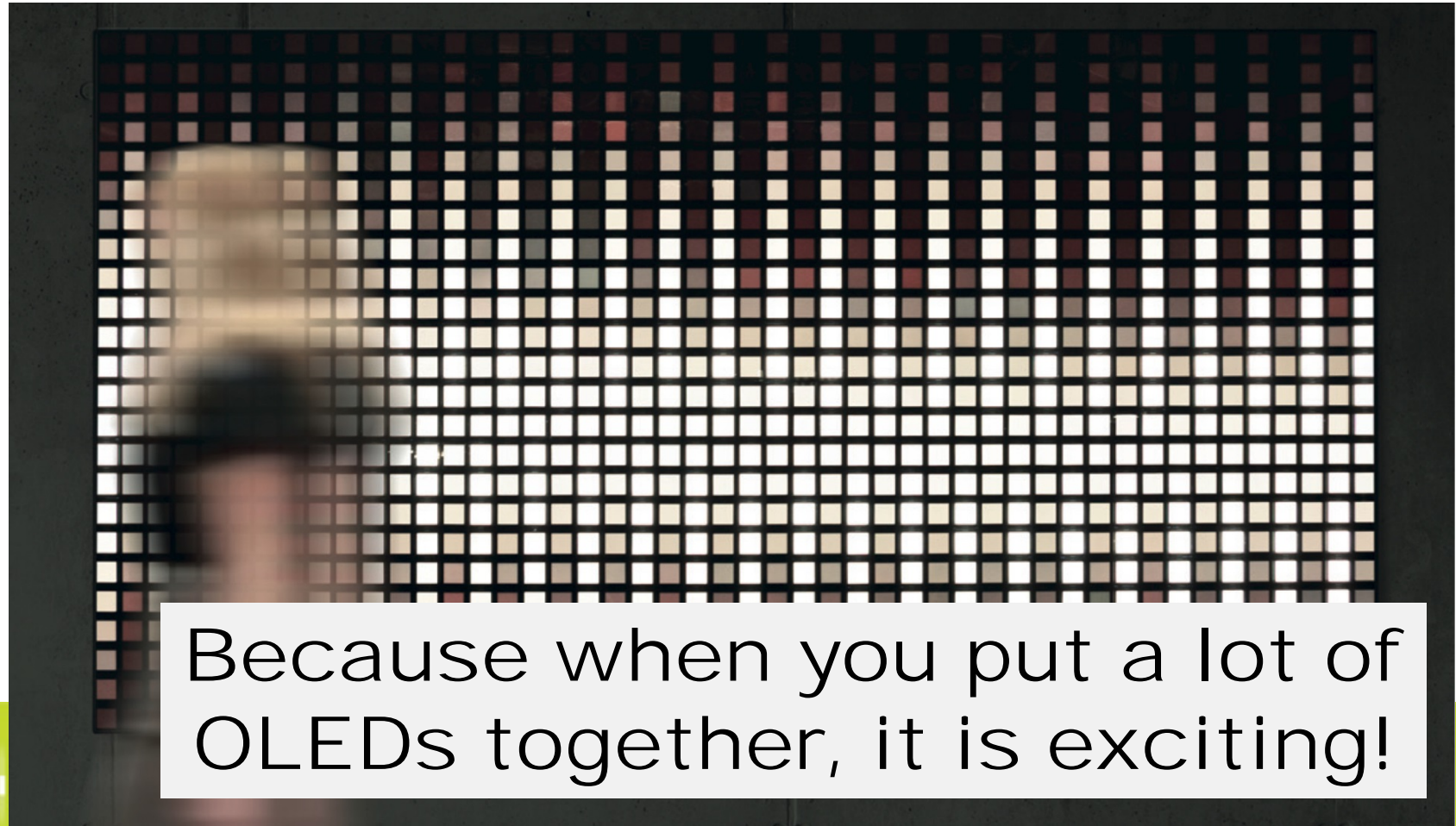
What are the advantages over Edge-lit LED panels

Is it expensive?

Is anyone making any money Selling OLED's?

How do we get the OEMs to buy OLED's?

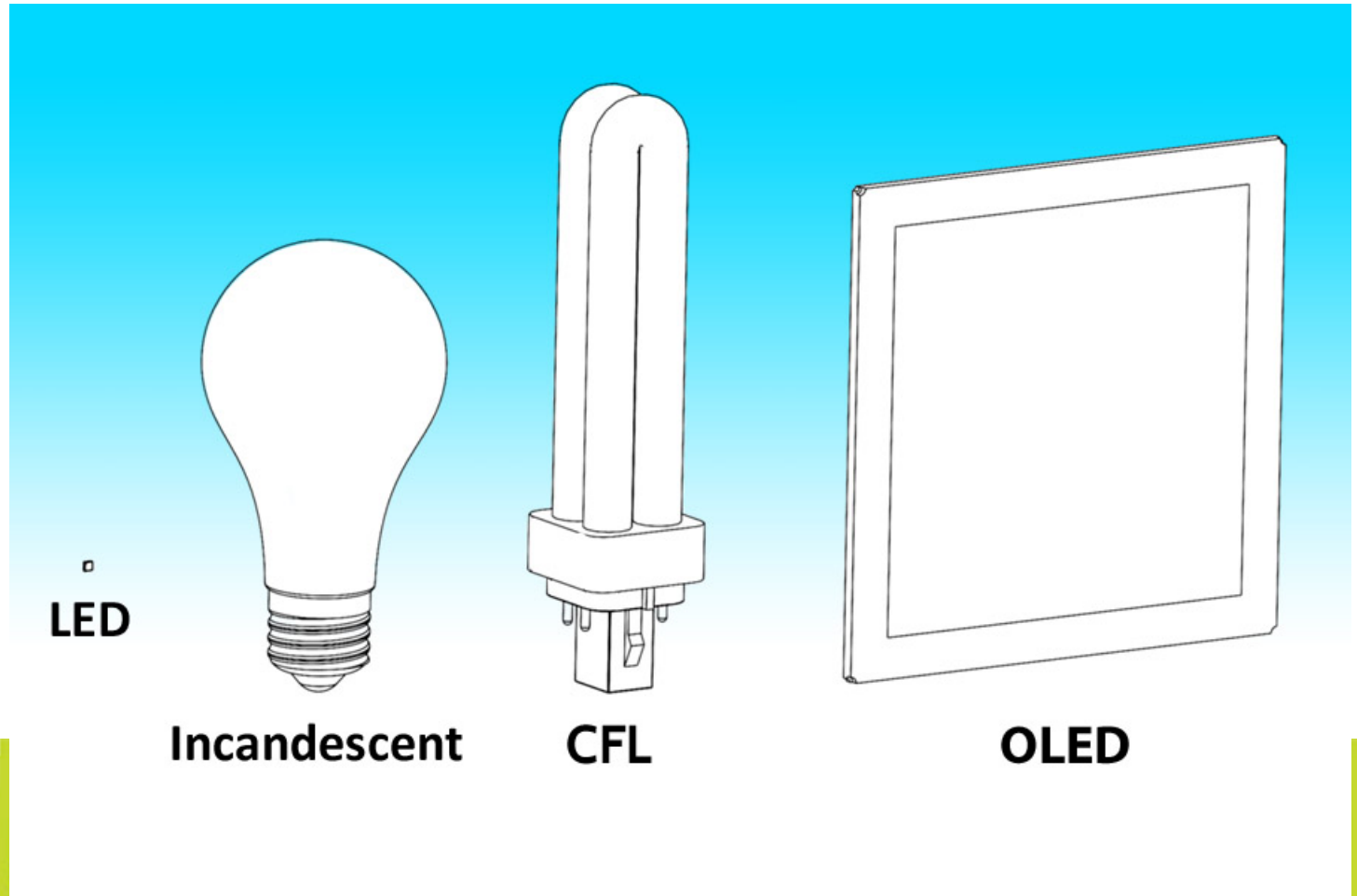
Why does everyone like OLEDs?



Because when you put a lot of OLEDs together, it is exciting!

Why do I like OLEDs

It is All
About
Scale!



Basic LEDs are not “Light Bulbs”

- “Light Bulbs” are omni-directional, Individual LED’s have a generally directional distribution.
- Most LED’s require diffuser, optical lens or other component to control and diffuse the light.
- Individual LED’s have a high surface brightness (small bright point source).
- To replicate a simple “light bulb” it takes many LED’s and it requires an assembly of housings, electronics, heat sinks and diffusers.

OLEDs can become the first real SSL “Light bulb”.

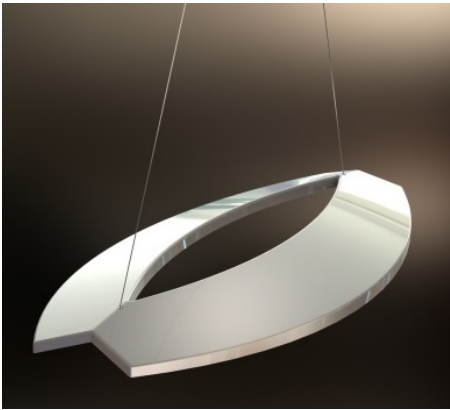
- OLED is a unitary, self contained light source
- Can be used with or without a diffuser
- Even, Lambertian type of light distribution
- Low surface brightness (panel source of light)
- (Could be) easy to re-lamp
- (Could have) integrated socket

What can you do with an OLED
“Light Bulb” in a decorative fixture



Our exploration in decorative OLED concepts

Can use multiple OLED panels, behind a diffuser

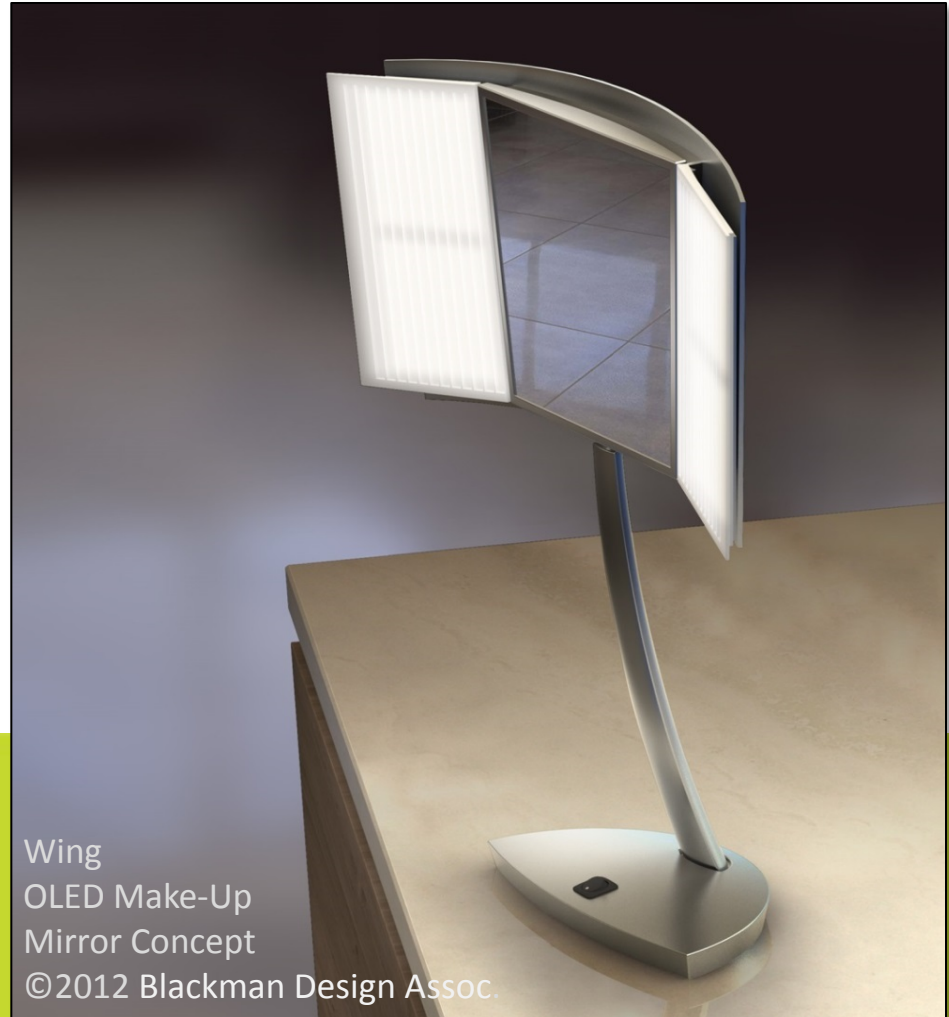
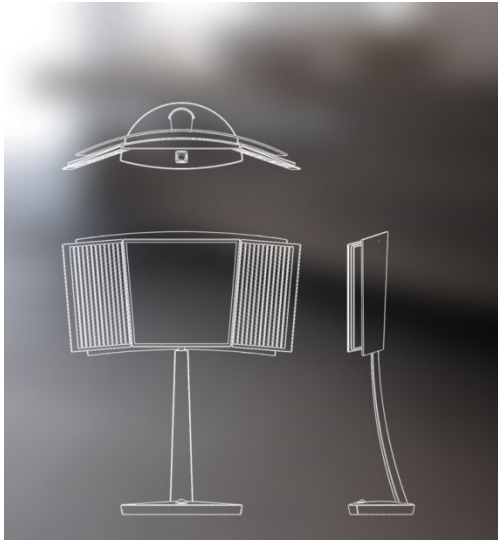


Aeros OLED linear
Pendant Concept
©2012 Blackman Design Assoc.



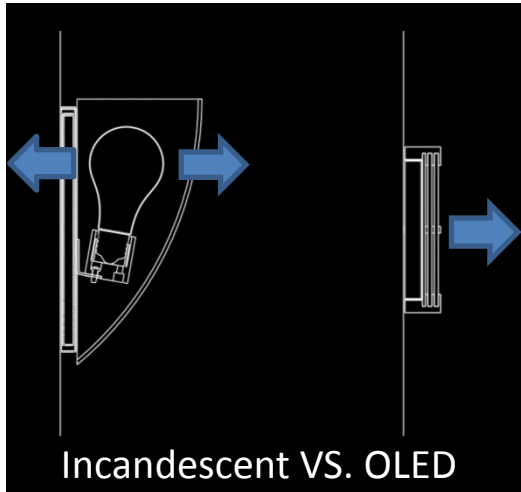
Our exploration in decorative OLED concepts

Good for low glare ambient and task illumination



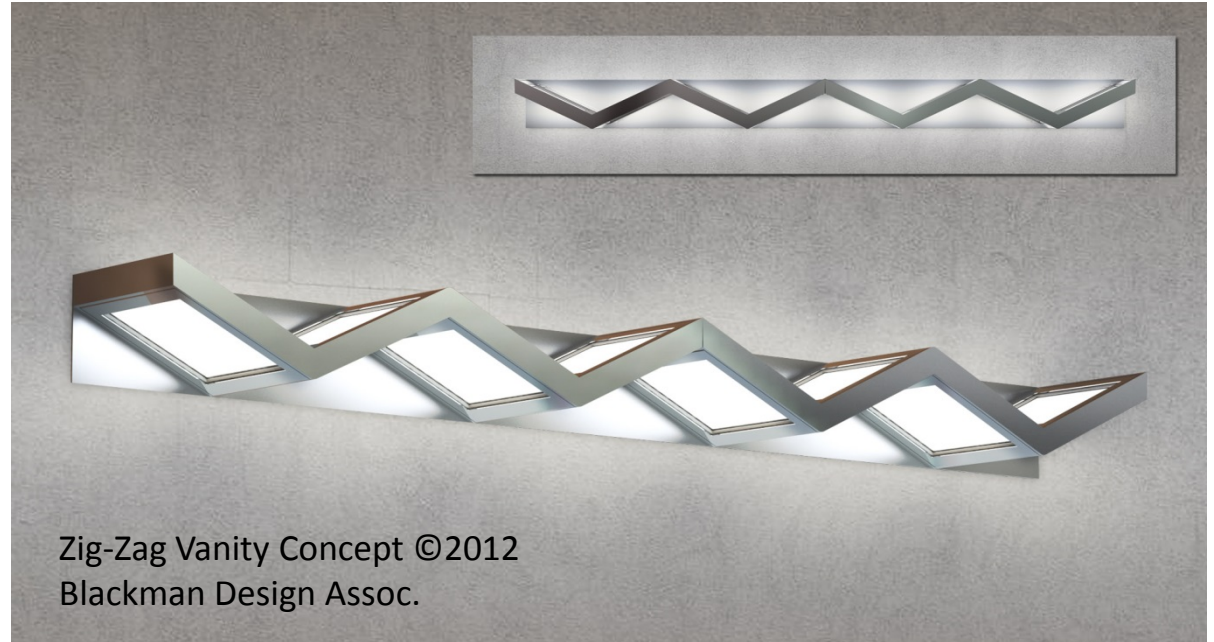
Our exploration in decorative OLED concepts

Use as “back to the wall” directional light



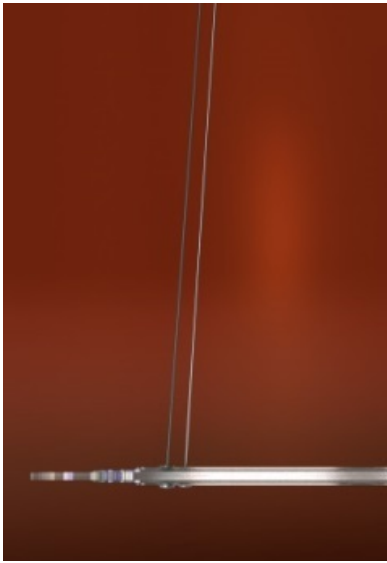
Our exploration in decorative OLED concepts

Double Sided housing provides wide 360 degree distribution



Our exploration in decorative OLED concepts

Uniquely
Thin



Zenz OLED Pendant
Concept ©2012,
Blackman Design Assoc.



Our first OLED production fixture

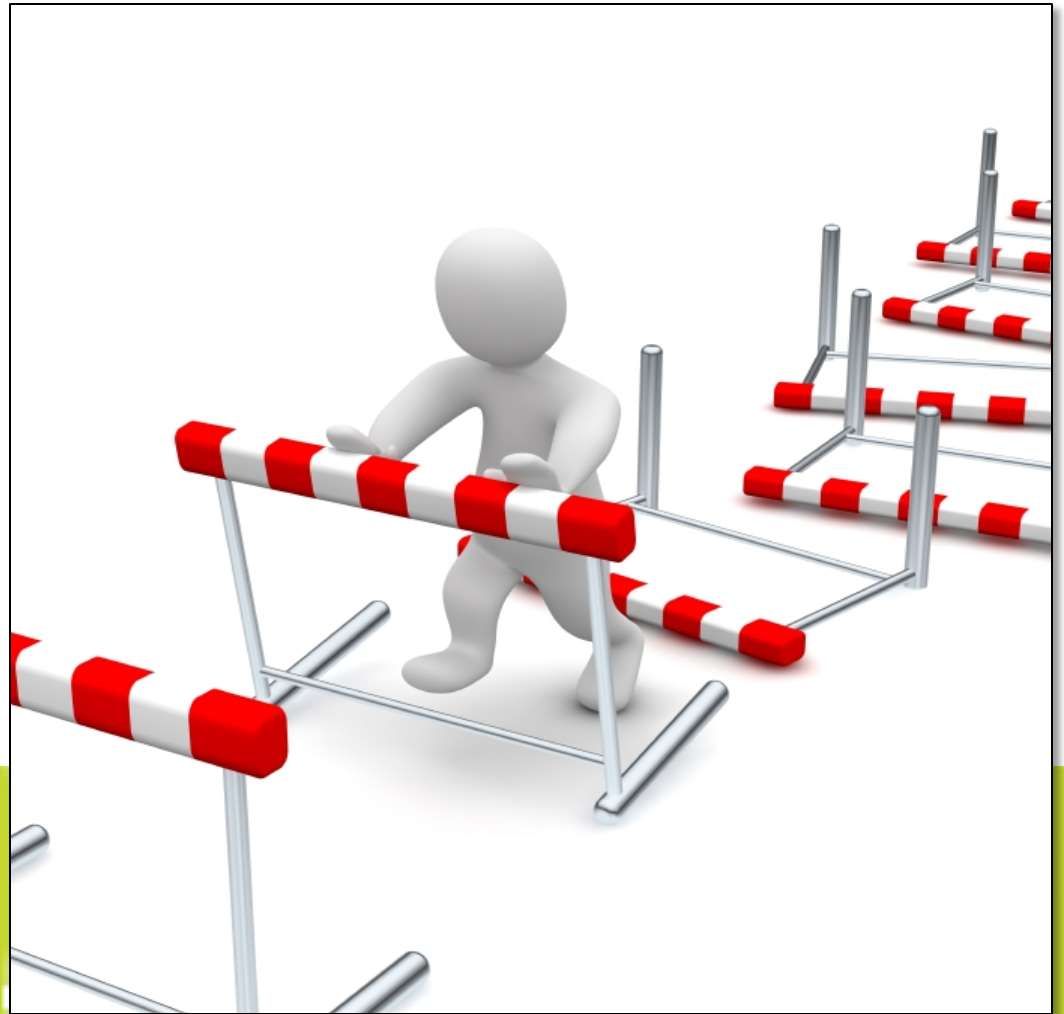
OLED Chandelier and Wall sconce
(released May 2012)



**Vela OLED
Chandelier,
WAC
Lighting**



Obstacles slowing OLED fixtures' market acceptance



Obstacles slowing acceptance of OLED lighting fixtures

Problem:

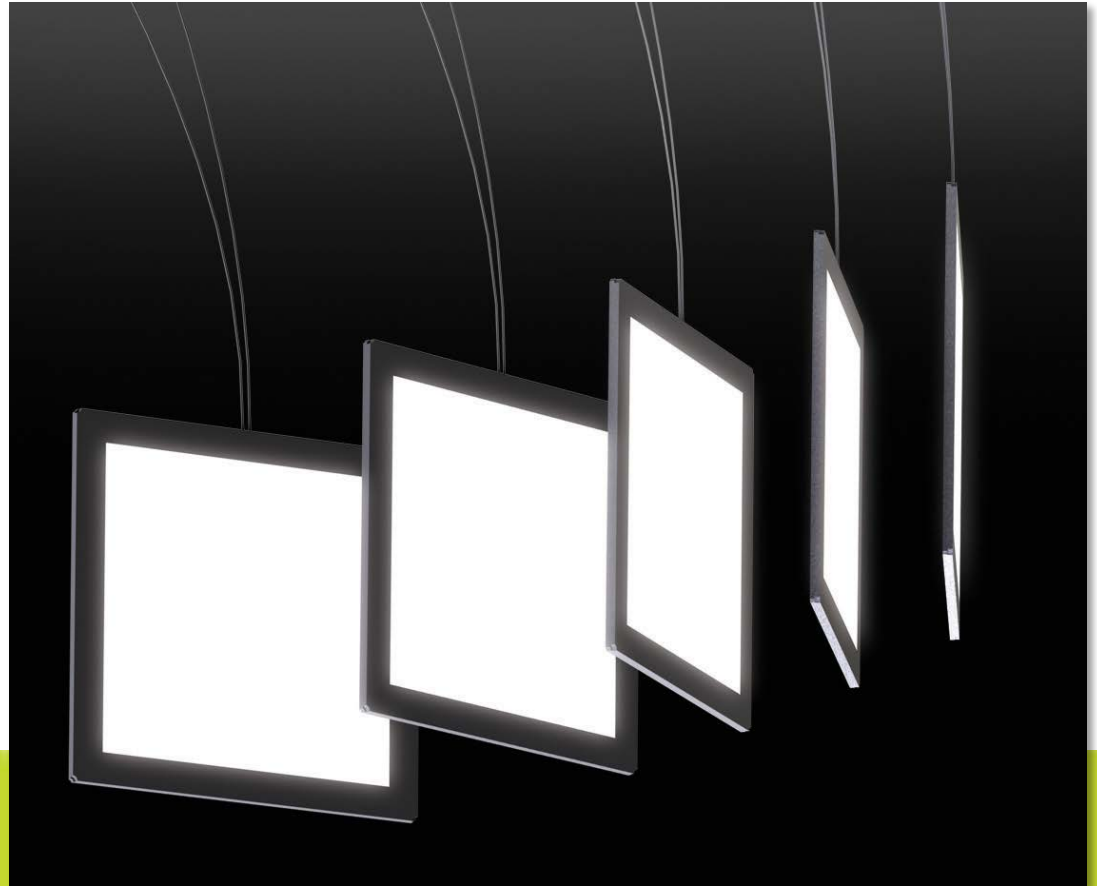
High Fixture
Cost

\$44 KLM

Fluorescent fixture

VS. \$2900 KLM*

OLED fixture



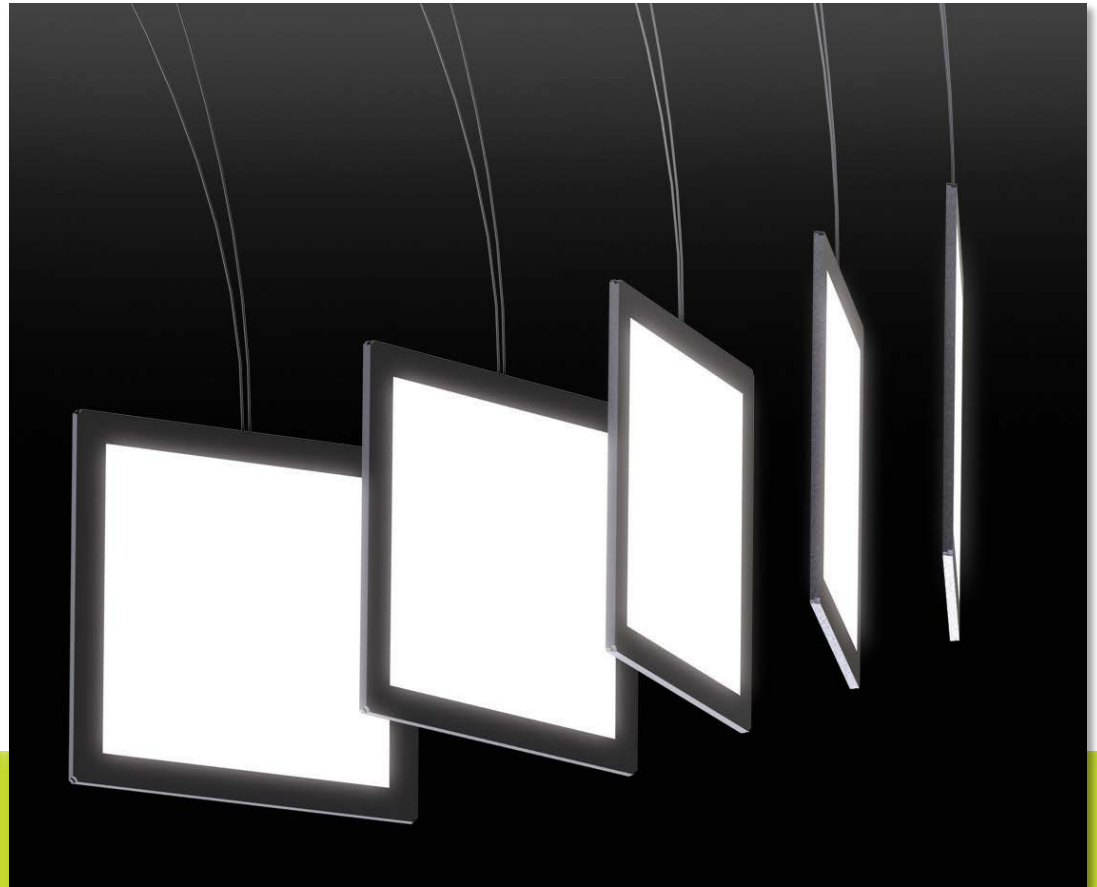
*Source: US DOE, SSL Multi-Year Plan of 2013

Obstacles slowing acceptance of OLED lighting fixtures

Problem:

Low Efficacy

120 L/W **LED** light
source VS. 45 L/W
OLED panel

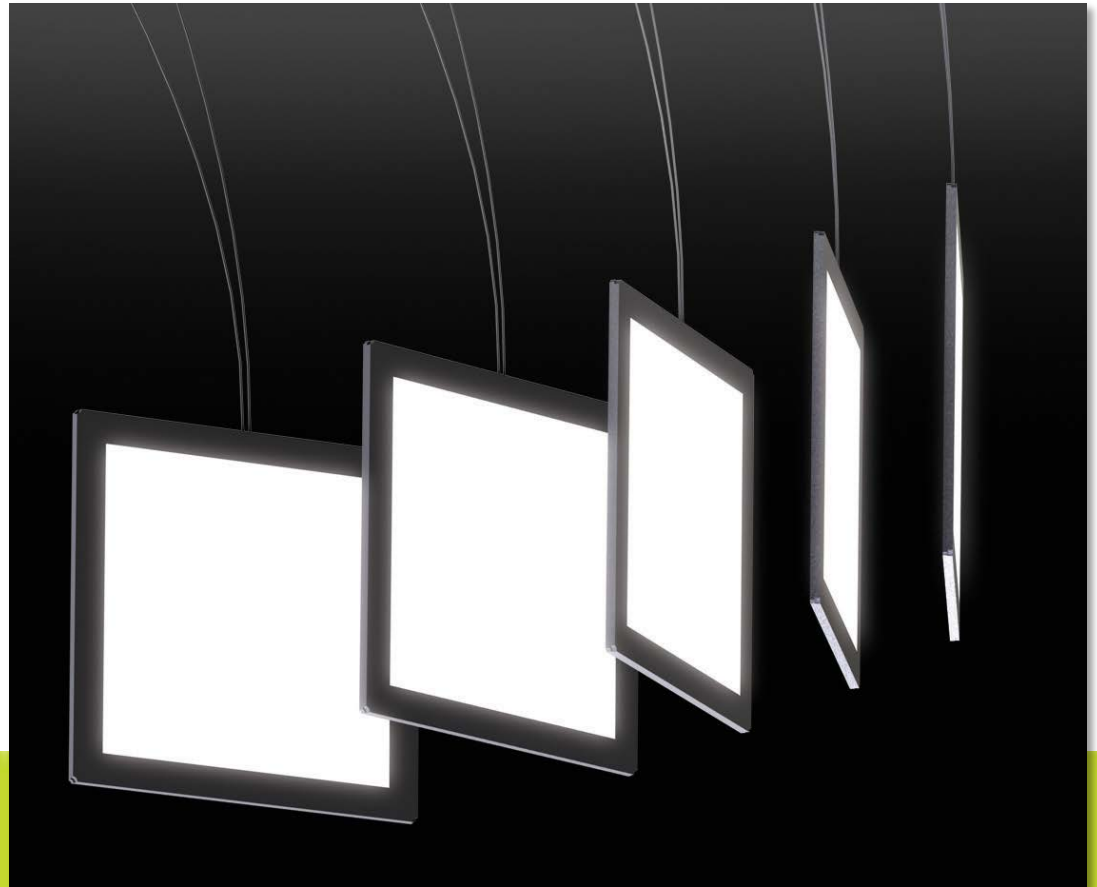


Obstacles slowing acceptance of OLED lighting fixtures

Problem:

Short Life Span

42,000 hour T8
Fluorescent tube VS.
12,000 hour OLED
panel.



Obstacles slowing acceptance of OLED lighting fixtures

Problem:

Glass Breakage

No standard support
or mechanical
attachment methods
for holding delicate
panels in place



Obstacles slowing acceptance of OLED lighting fixtures

Problem:

Lack of OLED Panel Standardization

- Similar to CFL development problems.
- Size and output of OLED sources need industry standards



Obstacles slowing acceptance of OLED lighting fixtures

Problem:

Lack of OLED Socket Development

- Can result in confusion and too many choices.
- Need standard connector for ease of installation and to promote use of OLED's by OEMs.

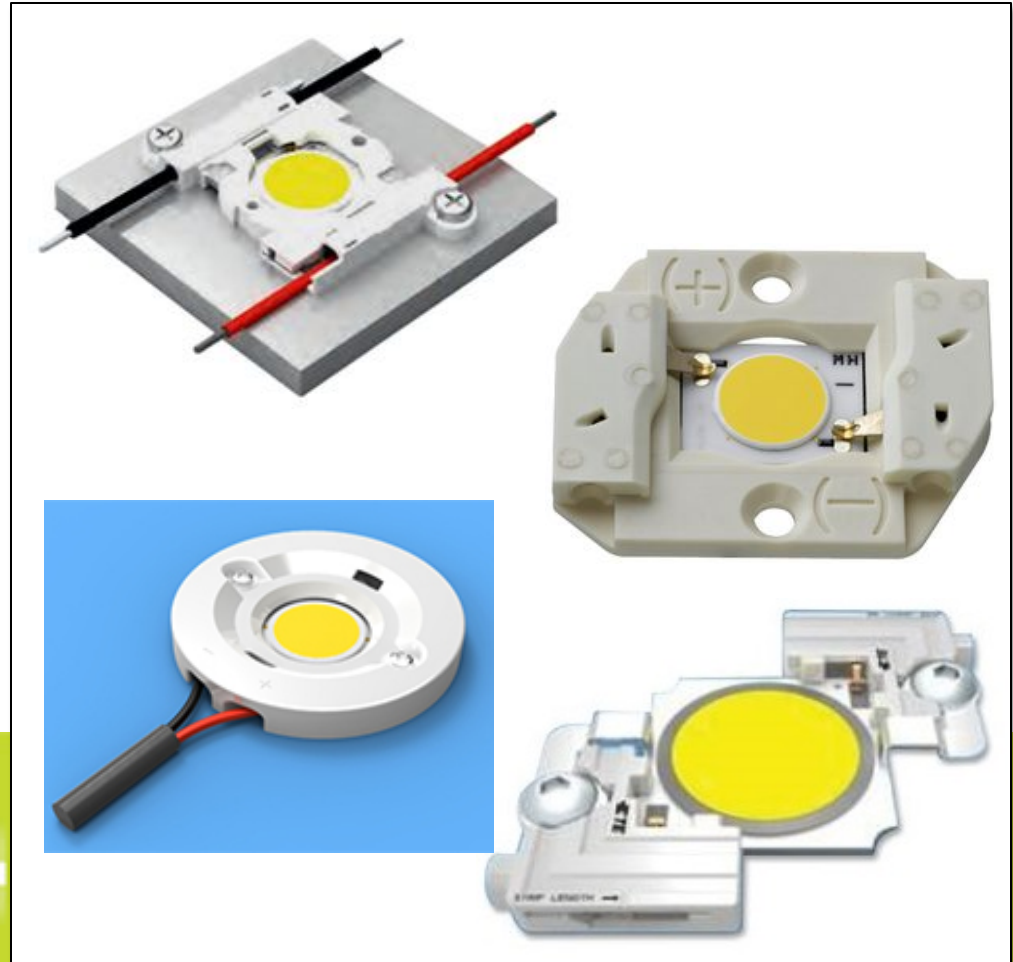


Obstacles slowing acceptance of OLED lighting fixtures

Problem:

OLED Components
Aren't Designed for
Lighting Industry

- Need to make products conform to industry practices.
- LED COB sockets are example of growing lighting niche due to ease of use.



The dilemma of using OLEDs:

1- How do we promote a new flat panel light source, and a shape, that has not yet been accepted by the industry?

2- How do we justify expensive, low efficient technology that is still at its infancy?

Our short term solution:

Want to promote OLED light sources in the long term

But

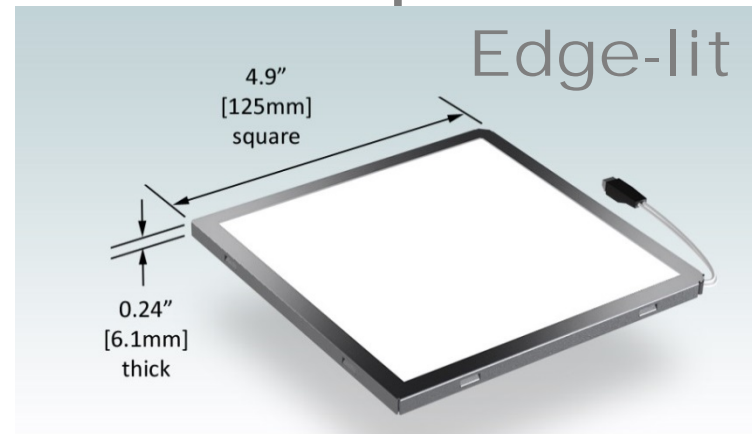
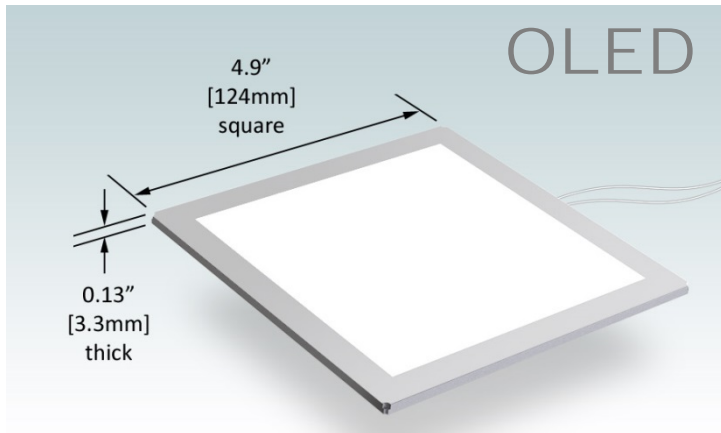
**We need to produce fixtures that will be efficient and
can be affordably sold now.**

Solution

**Create the demand in the industry for small flat panel
light sources...**

...by using compatible Edge-lit LED panels.

OLED / Edge-lit LED comparison



\$835 KLM OLED Panel

vs.

\$85 KLM Edge-lit Panel*

45 Lum./W OLED Panel

vs.

85 Lum./W Edge-lit Panel*

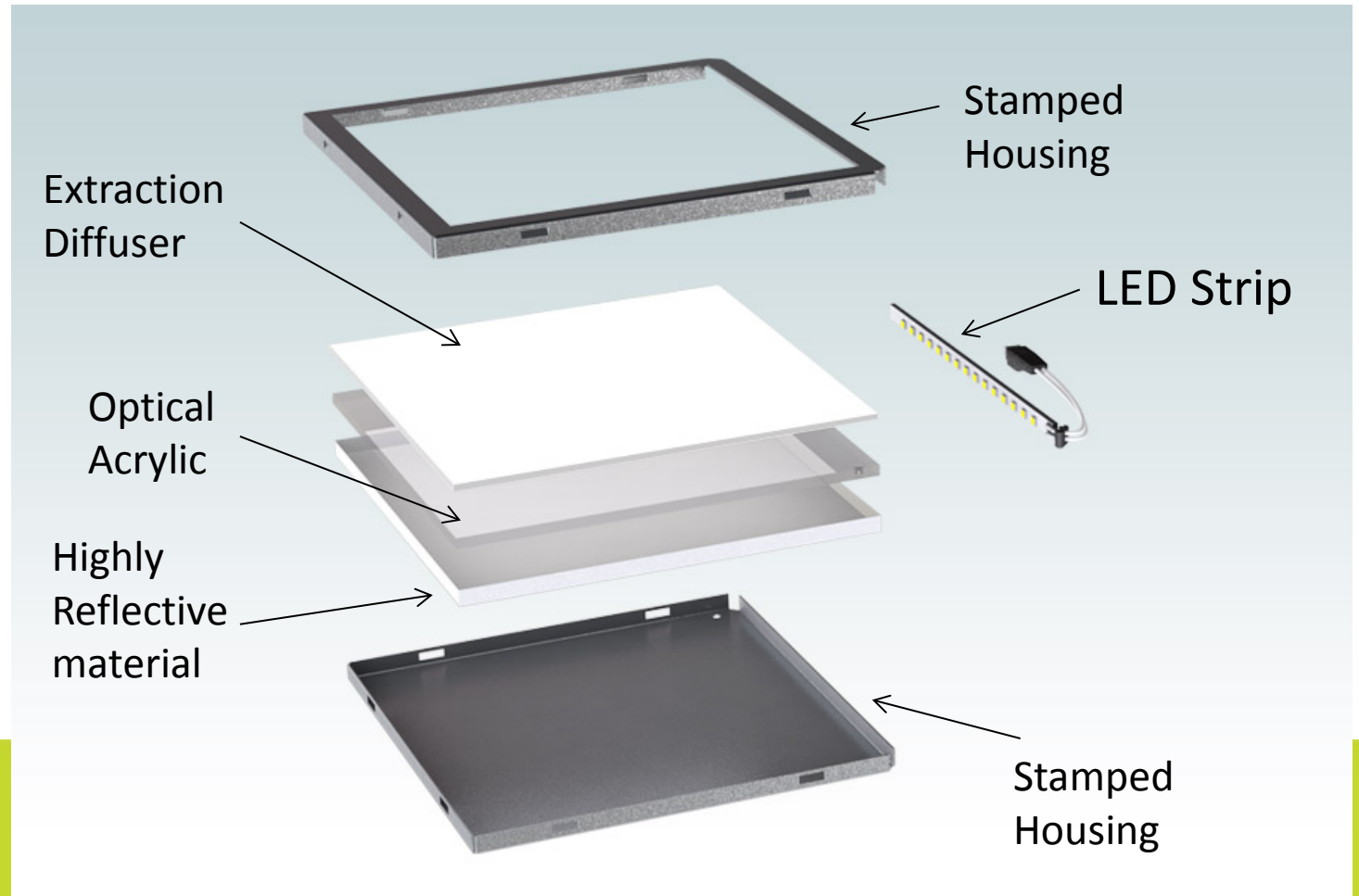
10 - 15K hr. OLED Panel

vs.

40 - 50K hr. Edge-lit Panel*

* Approximate specifications, using currently available Edge-lit panel with mid-powered LEDs /and currently available OLED 100 x 100mm panels

Edge-lit LED panels



Our recent work in edge-lit LED

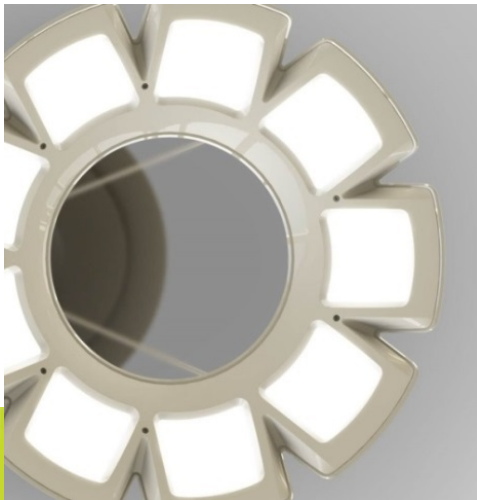
Flat panel lighting can influence and alter the look and shape of task and portable lighting



Aradess LED Table Lamp,
BlackJack Lighting 2014

Our recent work in edge-lit LED

Flat panel lighting allows use of new, unique shapes and materials



What does the future look like
for flat panel illumination



The future looks “bright” for edge-lit panels in lighting

Edge-lit lighting is making in-roads into certain large scale and decorative fixture categories today

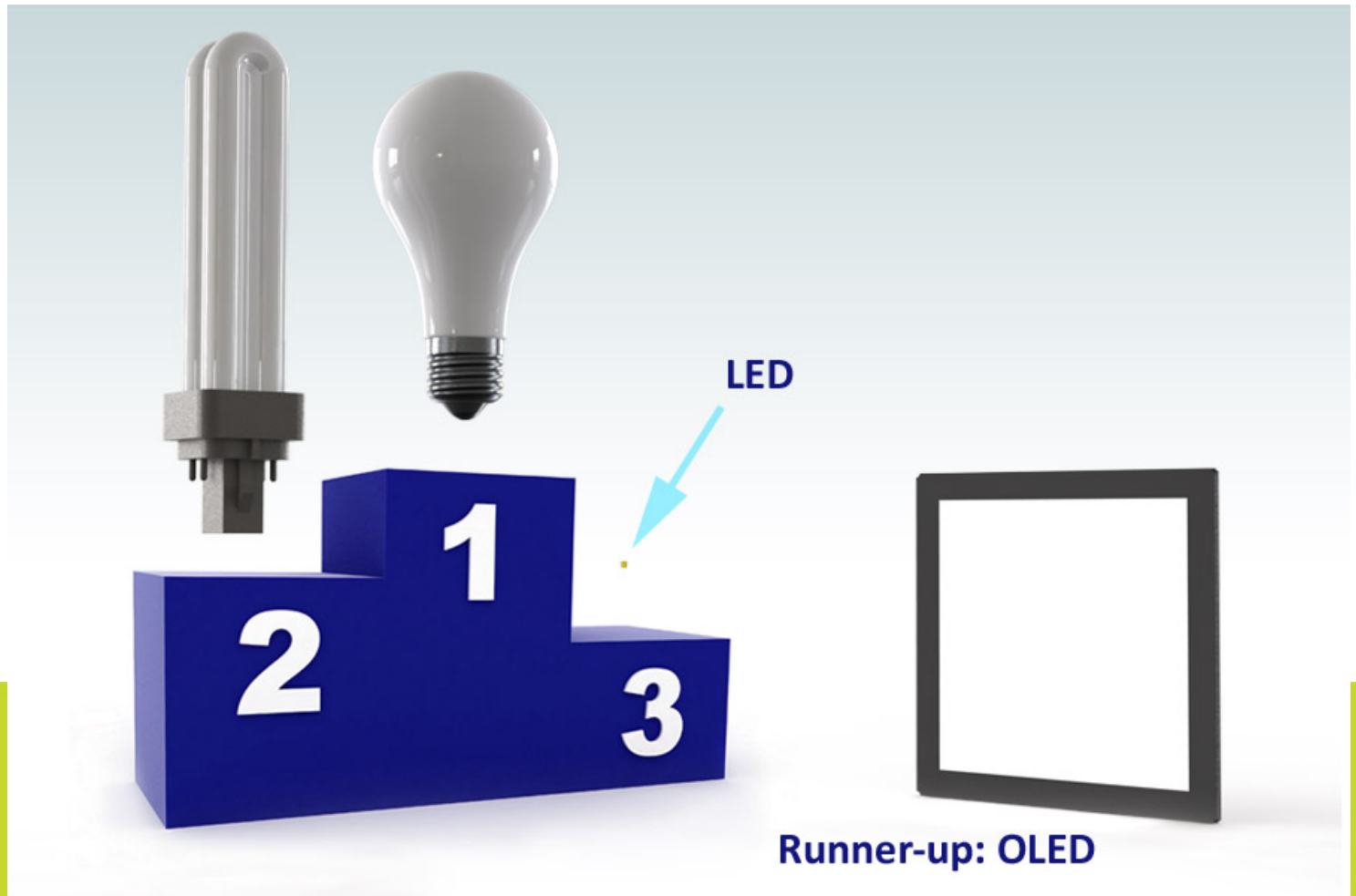


In 2013- An average **edge-lit LED** 2x2 fixture has **90 L/W, 50K Life,** and cost **\$83/ KLM**



In 2013- An average **T5HO 2x2** fixture has **70 L/W, 24K Life,** and cost **\$44/ KLM**

What does the future look like for OLED in lighting



What does the future look like for OLED in lighting

According to the SSL Multi-Year Plan of 2013 from the U.S. Dept. of Energy, in the next six years...



What does the future look like for OLED in lighting

Multi-Year Program Plan

TABLE 3.9 BREAKDOWN OF OLED LUMINAIRE EFFICIENCY

Metric	2013	2015	2020	Goal
Panel Efficacy ¹ (lm/W)	80	100	140	190
Optical Efficiency of Luminaire	85%	88%	92%	95%
Efficiency of Driver ²	88%	91%	93%	95%
Total Efficiency from Device to Luminaire	75%	81%	86%	90%
Resulting Luminaire Efficacy ¹ (lm/W)	60	81	120	171

Notes:

1. Efficacy projections assume CRI >80, CCT 2580-3710 K
2. Drive efficiency for OLED luminaires is not well characterized, given the small number of products available

Luminaire
Efficacy might
be **120**
Lumens/ watt

OLED panel
life could be
30,000 hours

Multi-Year Program Plan

TABLE 4.3 SUMMARY OF OLED PANEL PERFORMANCE TARGETS

Metric	2013	2015	2018	Goal
LER (lm/W)	320	330	350	360
Internal Quantum Efficiency	85%	90%	90%	90%
Electrical Efficiency	75%	80%	85%	85%
Extraction Efficiency	40%	50%	60%	70%
Panel Efficacy (lm/W)	80	100	120	190
L ₇₀ Lumen Maintenance (1,000 hours)	15	20	25	30

Note: Projections assume CRI > 85, 2580-3710K, 10,000 lm/m² emittance.

Multi-Year Program Plan

TABLE 4.5 OLED PANEL AND LUMINAIRE MILESTONES

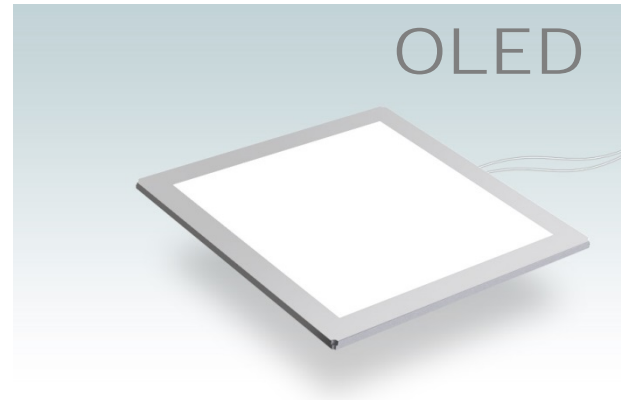
Year	Target
FY10	Panel: >60 lm/W
FY12	Laboratory panel: 200 lm/panel; >70 lm/W; >10,000 hours
FY15	Commercial panel: <\$50/klm (price); >100 lm/W; 20,000 hours
FY18	Luminaire: 100 lm/W
FY20	Luminaire: price <\$50/klm

Note: CRI > 85, CCT < 2580-3710 K

Luminaire Prices may
be **below \$50/ KLM**

What does the future look like for OLED in lighting

OLED panels can become the next multi-use “light bulb”



In 2013- An average 18W CFL has 65 L/W, 24K Life

In 2020- An average OLED panel may have 120 L/W, 30K Life

What does the future look like for OLED in lighting

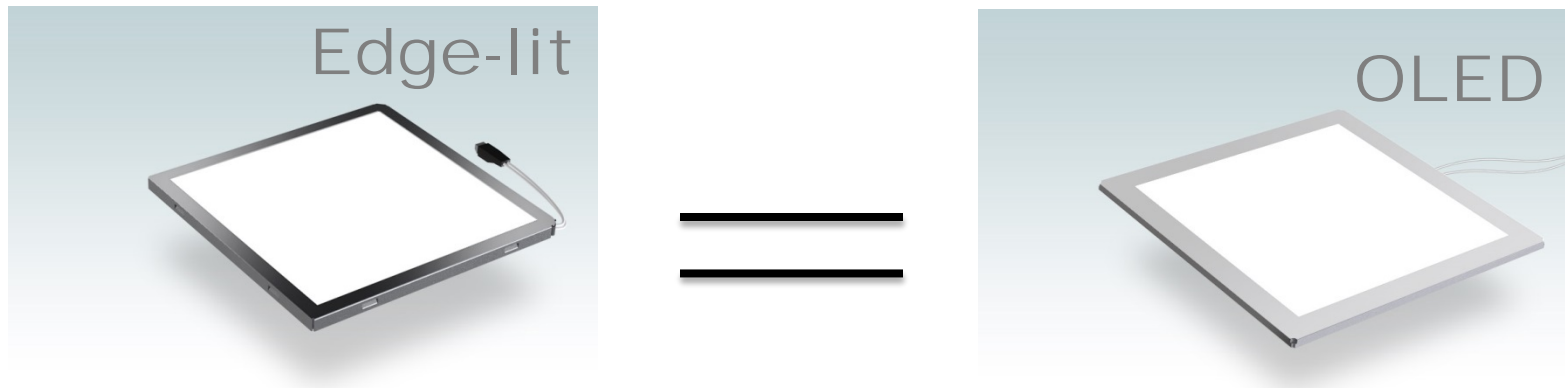
“Back Against the Wall” CFL fixture applications* (retrofit and new) can use OLED's as “light bulbs”



*Fixtures with diffusers and less than 2000 Lumens, (i.e. outdoor lanterns, interior sconces, flush mounts, vanities, emergency lighting, etc.)

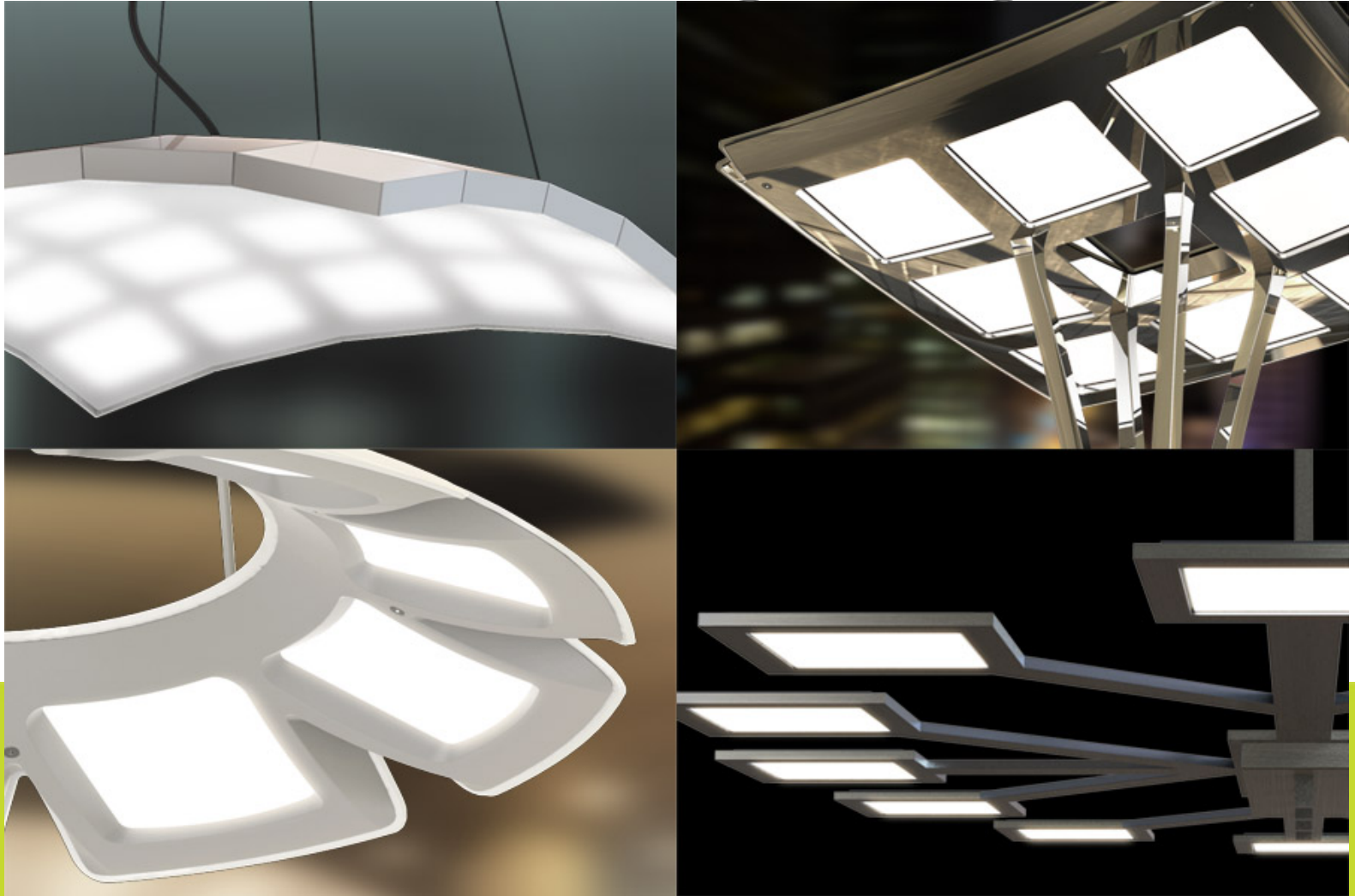
What does the future look like for OLED in lighting

In 2020 -If an OLED fixture has 120 L/W, 30K Life, and cost below \$50/ KLM, THEN.....



...OLED “light bulbs” can then replace edge-lit panels in a variety of flat panel fixture applications

What does the future look like for OLED in lighting



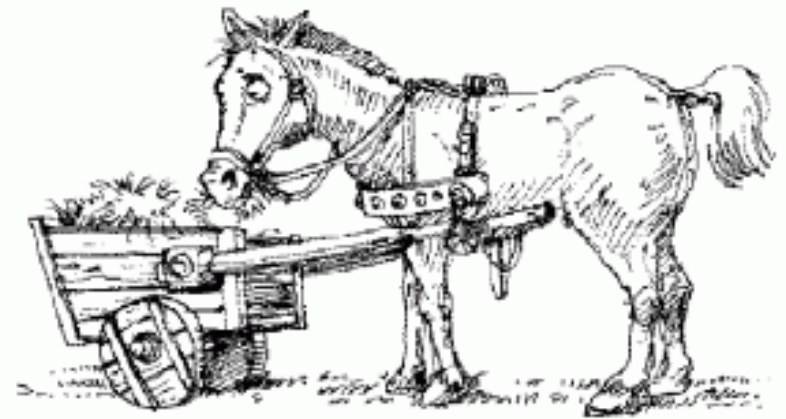
What are the next steps for OLED in the lighting industry

Suggestion:

1-Establish the need in the market for flat panel light sources.

2-Improve the life, efficacy, and cost of OLED,

3-Create standardization in size, shape and socket for the OLED



PUTTING THE CART BEFORE THE HORSE

What are the next steps for OLED in the lighting industry

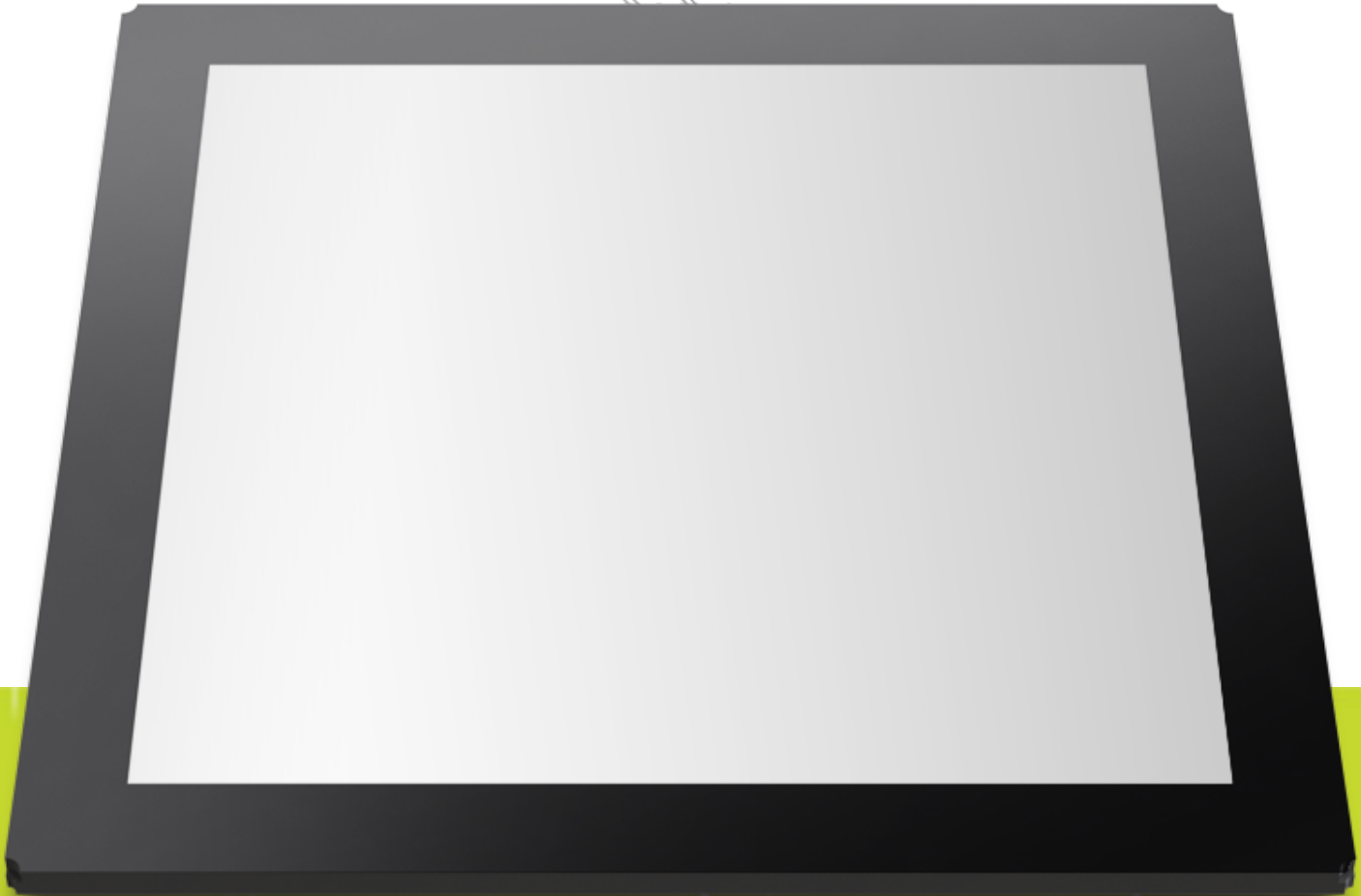
Suggestion:

Think of OLED as a new type of “light bulb”.

Adjust industry expectation for when OLED will be viable.

And then be patient!

Thank you!



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L I G H T I N G